

## THE CLAIMS:

1. A scanning device for: scanning coded data disposed on a surface; and generating interaction data based on the sensed coded data, the interaction data being indicative of interaction of the scanning device with the surface; the coded data including, at a plurality of locations on the interface surface, a corresponding plurality of coded data portions, the scanning device comprising:
  - 5 (a) a laser source and scan optics configured to emit a scanning beam through an aperture in a housing of the scanning device, the scanning beam being directed in first and second orthogonal directions to thereby generate a raster scan pattern over a scanning patch, the scanning patch being positioned to cause the exposure of the at least one coded data portion when the surface and the sensing device are positioned operatively with respect to each other;
  - 10 (b) a photodetector for detecting reflection of the scanning beam from the surface, thereby to capture sample information;
  - (c) at least one analog to digital converter for converting the captured sample information into sample data;
  - 15 (d) a first framestore for storing successive sample data as image data;
  - (e) an image processor for processing the image data to generate processed image data;
  - (e) a host processor for generating the interaction data based at least partially on the processed image data.
2. A scanning device according to claim 1, wherein the photodetector and the at least one analog to digital converter are integrated on a monolithic integrated circuit.
- 20 3. A scanning device according to claim 2, wherein the framestore is integrated on the monolithic integrated circuit.
4. A scanning device according to claim 3, wherein the image processor is integrated on the monolithic integrated circuit.
- 25 5. A scanning device according to claim 1, wherein the image processor includes subsampling means for subsampling the image data from the first framestore to generate subsampled image data.
6. A scanning device according to claim 4, further including a first subsampled framestore for storing the subsampled image data based on image data from the first framestore.
7. A scanning device according to claim 1, further including a second framestore integrated on the monolithic integrated circuit, the scanning device being configured such that the first and second framestores respectively store alternate frames of the image data associated with alternate frames of image information sensed by the photodetector.
- 30 8. A scanning device according to claim 7, including first and second subsampled framestores, wherein the first and second subsampled framestores store subsampled image data based on image data from the first and second framestores respectively.
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9. A scanning device according to claim 8, wherein the first and second subsampled framestores are integrated on the monolithic integrated circuit.

10. A scanning device according to claim 5, wherein the image processor includes a low-pass filter for low-pass filtering the image data prior to subsampling it.

5 11. A scanning device according to claim 5, wherein the image processor includes range expansion means for range expanding the subsampled image data.

12. A scanning device according to claim 10, wherein the image processor includes range expansion means for range expanding the subsampled image data.

10 13. A scanning device according to claim 1, wherein the image processor includes a low-pass filter for filtering the image data.

14. A scanning device according to claim 1, wherein the image processor includes a range expansion circuit for range expanding the digital image data.

15. A scanning device according to claim 1, wherein the photodetector comprises at least one photodetecting circuit, each of the at least one photodetecting circuits comprising:

15 a photodetector for generating a signal in response to the reflected laser radiation;  
a storage node having first and second node terminals, the first node terminal being connected to the photodetector to receive the signal such that charge stored in the node changes during an integration period of the photodetecting circuit; and  
an output circuit for generating an output signal during a read period of the photodetecting  
20 circuit, the output signal being at least partially based on a voltage at the first terminal;  
the photodetecting circuit being configured to:  
receive a reset signal;  
integrate charge in the storage node during an integration period following receipt of the reset signal; and  
25 receive a compensation signal at the second terminal of the storage node at least during the read period, the compensation signal increasing the voltage at the first terminal whilst the output circuit generates the output signal.

16. A scanning device according to claim 15, wherein the compensation signal is a logically negated version of the transfer signal.

30 17. A scanning device according to claim 1, the photodetector circuit being a CMOS circuit.

18. A scanning device according to claim 1, wherein at least one of the image processor and the host processor is disposed on a monolithic integrated circuit, the monolithic integrated circuit including:

timing circuitry for generating:  
35 at least one internal timing signal, the photodetector being responsive to at least one of the internal timing signals to at least commence scanning of the image information; and

at least one external timing signal;

at least one external pin for supplying the at least one external timing signal to at least one peripheral device of the scanning device.

19. A scanning device according to claim 18, wherein the at least one internal timing signal includes a frame exposure signal.

20. A scanning device according to claim 18, wherein timing of at least one of the external timing signals is programmable relative to at least one of the internal timing signals.

21. A scanning device according to claim 20, wherein the timing is programmable by way of modifying a value stored in a register accessible by the timing circuitry.

22. A scanning device according to claim 18, wherein a duration of at least one of the external timing signals is programmable.

23. A scanning device according to any one of claims 21, wherein the at least one external signal includes a light source control signal.

24. A scanning device according to claim 23, wherein timing of the light source control signal is programmed to cause actuation of a light source prior to the internal timing signal causing the photodetector to commence scanning of the image data.

25. A scanning device according to claim 18, wherein the image processor includes a synchronous interface for outputting the image data serially to the host processor in reliance on a synchronising signal therefrom.

26. A scanning device according to claim 25, wherein the image processor and the host processor are disposed on different monolithic integrated circuits.

27. A scanning device according to claim 1, wherein the image processor and the host processor are disposed on respective first and second monolithic integrated circuits, and the image processor is configured to make each of a series of frames of the image data available to the host processor, the image processor being configured to:

receive a first message from the host processor indicative of the host processor not requiring further access to the image data prior to a subsequent frame synchronisation signal;

in response to the first message, cause at least part of the first monolithic integrated circuit is disposed to enter a low power mode; and

in response to a frame synchronisation signal, cause the part of the first monolithic integrated circuit in the low power mode to exit the low power mode.

28. A scanning device according to claim 27, configured to generate the frame synchronisation signal.

29. A scanning device according to claim 27, wherein the part of the monolithic integrated circuit includes at least some circuitry associated with the image processor.

30. A scanning device according to claim 27, wherein the image processor is configured to process the image data in accordance with an image processing function prior to the host processor accessing it.

31. A scanning device according to claim 1, wherein the image processor and the host processor are disposed on respective first and second monolithic integrated circuits, the image processor being configured to:

receive, from the host processor, a request for access to a next available frame of image data from a framestore;

in the event the frame of image data is available, send a message to the host processor indicative of the image data's availability; and

in the event the frame of image data is not available, wait until it is available and then send a message to the host processor indicative of the image data's availability.

32. A scanning device according to claim 31, wherein the first monolithic integrated circuit includes the framestore.

33. A scanning device according to claim 31, further including at least one output pin for serially outputting data from the first monolithic integrated circuit in accordance with an external synchronising signal, the output data being based at least partially on the image data.

34. A scanning device according to claim 31, wherein the image sensor and the image processor operate asynchronously with respect to each other.

35. A scanning device according to claim 31, wherein the image processor is configured to: receive a message from the host processor confirming that image data in the framestore is no longer required; and

in the event that new image data is received to be stored in the framestore prior to the message being received, discarding the new image data.

36. A scanning device according to claim 35, configured to, in the event that the new image data is discarded, record that a frame overrun has occurred.

37. A scanning device according to claim 35, being configured to, upon receipt of the message, set a flag in the image processor indicating that the framestore is ready to accept new image data.

38. A scanning device according to claim 1, wherein the image processor and the host processor are disposed on respective first and second monolithic integrated circuits, the first monolithic integrated circuit including:

at least one input pin for receiving command data from the host processor;

at least one output pin for transmitting the processed image data to the host processor in response to the command data.

39. A scanning device according to any one of claims 1, 31 or 38, wherein the surface is part of packaging or a label associated with a product item, or is part of the product item

itself, and wherein each of the at least one coded data portions is indicative of a product identity of the product item.

40. A scanning device according to claim 39, wherein the coded data encodes an EPC associated with the product item, and the interaction data includes the EPC.

5 41. A scanning device according to claim 39, wherein the interface surface includes at least one region, the region including coded data indicative of an identity of the region, and wherein the host processor determines the identity of the at least one region from at least some of the sensed coded data.

42. A scanning device according to claim 39, wherein the coded data portion is  
10 indicative of a position of the coded data portion on the interface surface, and wherein the host processor uses the sensed coded data portion to:

determine the identity of the interface surface;

determine position data representing at least one of:

(i) a position of the sensed coded data portion on the interface surface; and

15 (ii) a position of the scanning patch relative to the interface surface;

determine a description of the interface surface using the determined identity; and

identify the at least one region from the description and the position data.

43. A scanning device according to claim 39, wherein the scanning device includes  
20 at least one deflector for deflecting the scanning beam in the first and second orthogonal directions to generate the raster scan pattern.

44. A scanning device according to claim 43, wherein the at least one deflector includes at least one of:

a rotating mirror;

a rotating holographic element;

25 an acousto-optic deflector; and

a resonant scanning mirror.

45. A scanning device according to claim 39, including at least one beam controller for directing the at least one scanning beam along at least a selected one of a number of patch beam paths into the scanning region.

30 46. A scanning device according to claim 45, wherein each patch beam path extends into the scanning region at a respective angle.

47. A scanning device according to claim 45, wherein the beam controller includes at least one mirror for directing the scanning beam along a selected one of the patch beam paths.

48. A scanning device according to claim 47, wherein the beam controller  
35 comprises:

a first mirror;

a plurality of second mirrors; and

a controller which controls the position of the first mirror to reflect the scanning beam from a selected one of the second mirrors into the scanning region.

49. A scanning device according to claim 48, wherein each second mirror defines at least one patch beam path, and wherein the controller controls the position of the first mirror to thereby direct the scanning beam along a selected patch beam path.

50. A scanning device according to claim 1, further including communications means for communicating the interaction data to a computer system

51. A scanning device according to claim 39, wherein the coded data is printed using infrared ink, the scanning device being responsive in the infrared spectrum.

52. A scanning device according to claim 39, wherein the coded data includes a plurality of tags, each of which is indicative of: an identity of a region within which the tag lies; and of a reference point of the region; the region being associated with the surface, the reference point being indicative of the position of the tag within the region.

53. A scanning device according to claim 39, the coded data being disposed on the surface in accordance with at least one layout, the layout having at least order  $n$  rotational symmetry, where  $n$  is at least two, the layout including  $n$  identical sub-layouts rotated  $1/n$  revolutions apart about a centre of rotational symmetry of the layout, the coded data disposed in accordance with each sub-layout including rotation-indicating data that distinguishes the rotation of that sub-layout from the rotation of at least one other sub-layout within the layout, and wherein the host processor is configured to determine the rotation-indicating data of at least one of the sub-layouts, and to decode the coded data based at least partially on the determined rotation-indicating data.

54. A scanning device according to claim 39, the coded data being disposed on or in a substrate in accordance with at least one layout, the layout having at least order  $n$  rotational symmetry, where  $n$  is at least two, the layout encoding orientation-indicating data comprising a sequence of  $n$  symbols, each symbol being positioned at a respective one of  $n$  locations arranged about a centre of rotational symmetry of the layout, thereby such that decoding the symbol at each of the  $n$  orientations of the layout produces  $n$  representations of the orientation-indicating data, each representation comprising a different cyclic shift of the orientation-indicating data and being indicative of the degree of rotation of the layout, the host processor being configured to determine a relative rotation of the coded data by determining one of the representations of the orientation-indicating data.